LaTeX: A high quality document preparation system for S & T Literature

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June 21, 2012

Introduction

What is TEX?

1. TEX is a digital typesetting program created by Prof. Donald Knuth of Stanford University
2. Goals of designing:
   - allow anybody to achieve high-quality typesetting for books with reasonable amount of effort & time
   - provide a system that would give exactly the same output on all computers
3. It is completely a low-level markup & programming language
4. Popular means to typeset complex mathematical formulae
5. It requires high level of learning & time to build custom macros
6. A more straightforward way to access the power of TEX is to use a high-level package like LATEX

Introduction

What is LaTeX? (pronounced as Lah-tek, or Lay-tek)

1. LaTeX is essentially set a of higher-level macros for TeX program
2. Intends to provide a high-level language that uses the power of TeX
3. LaTeX was developed by Leslie Lamport during 1985
4. Now maintained & developed by the LaTeX3[1] Project
5. Current version - LaTeX2e
6. LaTeX can be extended by using the underlying macro language to develop custom formats
7. These macros are collected into packages
8. It provides pre-defined layouts for various S & T documents such as articles, books, reports etc.
9. Thus became the *de facto* standard for academic typesetting
10. It is a typesetting program, not a word-processor

[1] http://www.latex-project.org/

LaTeX vs. Word processors

1. Word processors are based on the principle of WYSIWYG
2. LaTeX uses a WYSIWYM approach
3. LaTeX is like HTML
4. LaTeX software handles pagination, alignments etc
5. Pre-set standard formats (paper, thesis, book)
6. LaTeX is greatly suited for writing large manuscripts
1. LaTeX is a free software
2. Platform, version independent (Unix, Windows)
3. Supports Bibliography management
4. Supports for Index creation

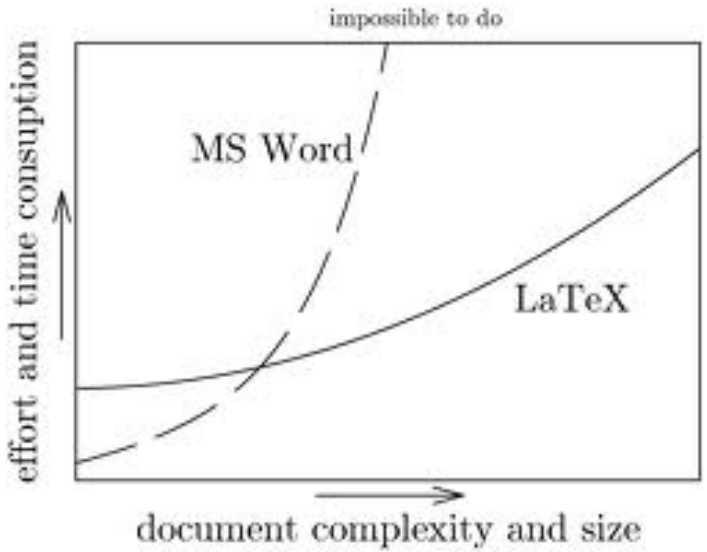


Figure: Complexity, effort & time comparison

Advantages & Disadvantages

1. Advantages:
   - LaTeX enforces proper typesetting
   - LaTeX is stable. It does not crash much and has low machine memory requirements
   - LaTeX software packages are forward and backward compatible
   - Automatic figure positioning is more efficient.
   - Automatic generation of Tables of Contents, List of Tables, List of Figures
   - Professional quality output
   - Source file format is not bounded to a particular OS or platform
2. Disadvantages:
   - Spelling/grammar checking is not as convenient as those in MS Word
   - Need to remember some commands
   - Creating complex tables in Latex may be time consuming
   - Not integrated with other MS Office products

Getting LaTeX

- To use LaTeX locally on a computer, we need to install a TeX distribution
- Distributions for major operating systems:
  - TEXLIVE[1] is a major TeX distribution for Unix/Linux, Mac & Windows
  - MIKTEX[2] is a Windows-specific distribution
  - MACTEX[3] is a Mac OS-specific distribution based on TeX Live
- It is likely that LaTeX comes a part of the Linux OS

Editors:

- Common LaTeX specific editors to use are TeXworks, TeXnicCenter, LyX, TeXmaker, TeXstudio, WinShell, WinEdt and Led
- Any text editor can be used (e.g. Notepad, Emacs, Vi, etc. & not a word processor (Word or OpenOffice)

Viewers:

- Normally LaTeX saves the final output as a DVI (.dvi) file
- All LaTeX distributions have a DVI viewer
- The pdflatex compiler produces PDF files directly

[1] http://www.tug.org/texlive/

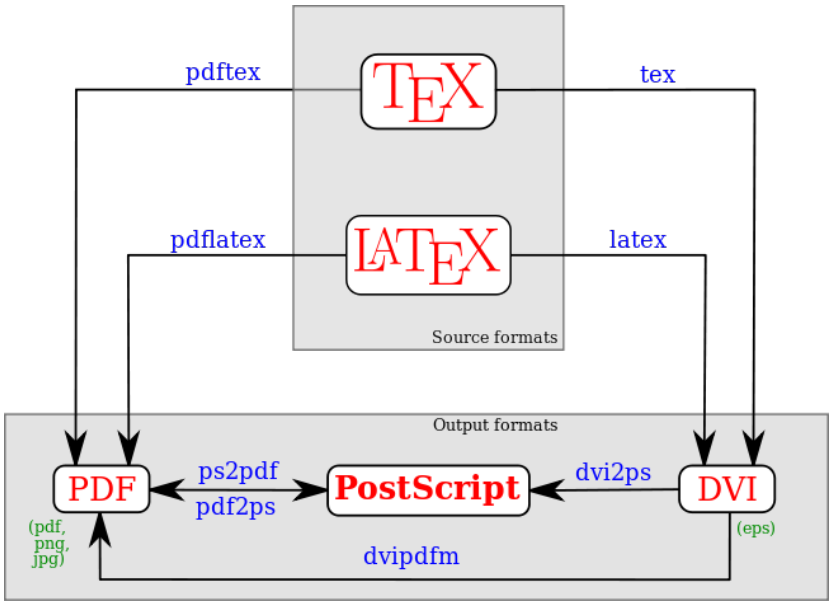
[2] http://www.miktex.org/

[3] http://www.tug.org/mactex/

Overview of the LaTeX System

Applications within the distribution:

1. latex compiler - reads a LaTeX (.tex) file and creates a .dvi as output
2. pdflatex compiler - reads a LaTeX file and creates a .pdf
3. dvi2ps - converts the .dvi file to .ps (postscript).
4. dvi2pdf -converts the .dvi file to .pdf
5. A .dvi viewer is available
6. TeX and pdfTex compilers are also included



- boxed red text represents the file formats
- the blue text on the arrows represents the commands
- Small dark green text under the boxes represents the image formats produced

Figure: Overview of the LaTeX system.

LaTeX Commands & Special Characters

1. LaTeX commands start with \ and have a name consisting of letters only
2. Some commands need an argument to be given within { .. }
3. Comments start with % and ends at the end of the line
4. Special characters: \, #, $, %, &, ~, _, ^, {, }
5. These characters cannot be used by themselves
6. To include these characters use the Escape Character \
7. The basic constructions in LaTeX involve various containers called environments
8. Environments are similar to commands, but have effect on wider part of the document
9. Environments start with `\begin{env_name}` and end with `\end{env_name}`

LaTeX Document Structure

1. LaTeX expects the input file to follow a structure
2. Accordingly, the contents of a LATEX document can be divided into:
   - preamble & top matter section
   - body of the document
   - the ending

Example (LaTeX source file)

```
% Example file
\documentclass{...}
\usepackage{...}

-------- Top Matter ----------

\title {Food Chemistry}
\author {Fennema}
\date {November 2008}

--- upto this is the preamble ---

\begin{document}   --> starts body
\maketitle         --> print the top matter

Hello World !      --> Actual content

\end{document}     --> end of document
```

The document class[options]....

1. The first information LaTeX needs to know, when processing an input file is the type of document the author wants to create
2. This is specified with the `\documentclass` command
   Syntax: `\documentclass[options]{class}  %` class specifies the type of document
3. Some of the document classes available in LaTeX are:

article	For manuscripts in scientific journals
IEEEtran	for articles with the IEEE Transactions format
proc	a class for articles in proceedings
minimal	only sets a page size and a base font. It is mainly used for debugging purposes
report	for longer reports like masters and phd thesis
book	For books
slides	for slides. The class uses big sans serif letters
memoir	based on the book class, can be used to create any kind of document
letter	for writing letters
beamer	for writing presentations

1. The options parameter customizes the behaviour of the document class
2. The options have to be separated by commas
   Syntax: `\documentclass[12pt,a4paper,twocolumn,draft]{report}`
3. New class files can be created modifying the above base class files

Package Inclusion

1. Add-on features for LaTeX are known as packages
2. Modern TeX distributions come with a large number of packages pre-installed
3. Packages are activated with the `\usepackage[options]{package_name}`

Example (Package inclusion)

```
\usepackage[options]{package_name}
\usepackage[options] {package1,package2,package3}
```

Some important packages are:

1. `graphicx` to manage external pictures
2. `amsmath, amssymb and amsthm` - for mathematical symbols & equations
3. `mhchem & chemfig` for chemical formulas
4. `color` - it adds support for colored text
5. `cite` - assists in citation management
6. `natbib` - gives additional citation options and styles
7. `hyperref` - gives LaTeX the possibility to manage hyper links
8. `geometry` - for easy management of document margins

The best way to look for LaTeX packages is the CTAN[1] Search

[1] http://www.ctan.org

The first LaTeX document

Example (Writing source file)

```
% Example1.tex  First Example

\documentclass {article}

\title{\LaTeX: A Document Preparation System}
\author{Leslie Lamport}

\begin{document}
\maketitle

Hellow World!

\end{document}
```

What does it all mean?

Compiling the LaTeX document

Example (How to compile?)

latex example1.tex
or
pdflatex exemple1.tex
or
From TeXworks select Typeset – Typeset
(Ctrl+T)
or
From WinEdt select
TeX – LaTeX
(Shift+Ctrl+L)

. . . . . .

Output written on example1.dvi (1 page, 480 bytes).
Transcript written on example1.log.

. . . . . .

[Example]

Sectioning Commands

1. LaTeX provides 7 levels for structuring our documents

Command	Level	Comments
`\part[]{part heading}`	-1	not in letters
`\chapter[]{chapter heading}`	0	only books and reports
`\section[]{section heading}`	1	not in letters
`\subsection[]{heading}`	2	not in letters
`\subsubsection[]{heading}`	3	not in letters
`\paragraph[]{paragraph}`	4	not in letters
`\subparagraph[]{subparagraph}`	5	not in letters

Table: Sectioning commands

2. Numbering of the chapters & sections is performed automatically
3. Parts get roman numerals (Part I, Part II, etc.)
4. Chapters and Sections get decimal numbering
5. Appendices are lettered (A, B, C, etc.)
6. By default numbering occurs upto subsection
7. For unnumbered section use the starred variation - `\chapter*{.....}`
8. To change the depth to which section numbering occurs use: `\setcounter{secnumdepth}{1}`

[Example]

Font size, style & paragraph alignment

Example

```
Font Size Environments
\begin{tiny}tiny\end{tiny}
\begin{scriptsize}scriptsize\end{scriptsize}
\begin{footnotesize}footnotesize\end{footnotesize}
\begin{small}small\end{small}
\begin{normalsize}normalsize\end{normalsize}
\begin{large}large\end{large}
\begin{Large}Large\end{Large}
\begin{LARGE}LARGE\end{LARGE}
\begin{huge}huge\end{huge}
\begin{Huge}Huge\end{Huge}

Font Style Commands
\textit{italic}
\textsl{slanted}
\emph{emphasize}
\textbf{boldface}
\texttt{typewriter}
\textsc{small caps}

Paragraph alignment Environments:
\begin{center}CENTER ALIGN\end{center}
\begin{flushright}RIGHT ALIGN\end{flushright}
\begin{flushleft}LEFT ALIGN\end{flushleft}
```

Font Size
tiny scriptsize footnotesize small
normalsize large Large
LARGE huge
Huge
Font Style
italic slanted emphasize
boldface `typewriter`
SMALL CAPS
Paragraph alignment:

CENTER ALIGN

RIGHT ALIGN

LEFT ALIGN

Some more formatting commands

1. Line Spacing:
   To overrride the default line spacing add:
   `\linespread{1.3}% at preamble`
   default 1; one and a half - 1.3; double 1.6
   setspace package allows more fine-grained control over line spacing
2. Horizontal Space:
   To change default horizontal space,
   use:`\hspace{length} % at preamble`
3. Vertical Space:
   To change default vertical space, use:
   `\parskip 7.2pt % at preamble`
   Additional space can be added by:
   `\vspace{length}`
   `% after the required line`
4. Fill the rest of the line:
   `\hfill` will produce spaces `\dotfill` will produce dots `\hrulefill` will produce a rule
5. Emphasizing Text:
   I want to `\emph{emphasize}` a word
6. Slash marks:
   `"input/output"` should be typeset as `"input\slash output`

Some more formatting commands

1. Dashes and Hyphens

Input	Output	Purpose
-	-	inter-word
--	–	page range, 1–10
---	—	punctuation dash

2. Superscript /Subscript:
   `\superscript{sample text}`
3. For subscript use math mode or other packages such as mhchem or fixltx2e `$H_2O$` will typeset H_2O
4. Hyphenation:
   LaTeX hyphenates words wherever necessary. In case the algorithm does not find proper hyphenation point for a word, we can specify using:
   `\hyphenation{hyphe-nation}` Also `\hyp` command of the `hyphenat` package can be used:
   Ex: `electromagnetic\hyp{}endioscopy`
5. To avoid hyphenation altogether
   `\hyphenpenalty=100000 % extreme value`
6. To change the degree of hyphenation:
   set `\tolerance=1000`

Footnotes, Marginal notes & Endnotes

1. To include footnotes use:
   `\footnote[number]{text}`
2. The footnote is automatically placed at the bottom of the page and is automatically given a number
   Example: `\footnote {This is a footnote}`[1]
3. To include margin notes use:
   `\marginpar[]{<note text>}`
4. Margin note placement goes as follows:
   - On the right for single sided documents
   - On the outside margin for double-sided documents

   Ex: `\marginpar{Here is a margin note.}`
5. To Include Endnotes require the use of the endnote package
   `\usepackage{endnotes} % at preamble section`
6. To create an endnote just use: `\endnote{text}`
7. Use the `\theendnotes` command at the end of the document where the endnotes have to appear
8. Within a paragraph environment these command may not work properly include a `\protect` command before it

[1] This is a footnote

Tables in LaTeX

1. Tables in LaTeX are highly customizable & can be simple or complex
2. Tables are created using the Tabular environment
3. Place a tabular environment only within a table environment which is able to float and add a label & caption

Example (Table Format)

```
\begin{table} [position specifier]
\centering  % centering the table horizontally
\begin{tabular} [pos]{table specification}
... table data goes here ....
\end{tabular}
\caption{This table shows some data.}
This caption will be added in list of tables
\label{tab:table1]
\end{table}
```

position specifier[optional]

```
tbp -   default
h   -   here
t   -   top
b   -   bottom
p   -   on extra page
```

Tables in LaTeX

Table specification:

Ex: \tabular{| l | c | r |}

1. l - left-justified column
2. c - centered column
3. r - right-justified column
4. p{width} - paragraph column with text vertically aligned at the top
5. m{width} - paragraph column with text vertically middle aligned
6. b{width} - paragraph column with text vertically bottom aligned
7. | - vertical line (single)
8. || - vertical line (double)
9. & - Column separator
10. \\ - New row
11. \hline - horizontal line
12. \newline - start a new line within a cell
13. \cline{i-j} - partial horizonal line from ith to jth column

[pos] - for vertical positioning:

b - bottom; c center (default); t - top

Tables in LaTeX - Examples

```
\begin{tabular} { l c r }
1 & 2 & 3 \\
4 & 5 & 6\\
7 & 8 & 9 \\
\end{tabular}
```

1	2	3
4	5	6
7	8	9

```
\begin{tabular} { | l | c || r| }
\hline
1 & 2 & 3
\hline
4 & 5 & 6
\hline
7 & 8 & 9
\hline
\end{tabular}
```

1	2	3
4	5	6
7	8	9

```
\begin{table}
\begin{tabular}{ | m{1 cm} | c | m{2 cm}| }
\hline
- &  - & inter-word
\hline
-- & -- & page range, 1--10
\hline
--- & --- & punctuation dash -- like this
\hline
\end{tabular}
\caption{Example Table}
\end{table}
```

Input	Output	Purpose
-	-	inter-word
--	–	page range, 1–10
---	—	punctuation dash – like this

Table: Example Table

Importing Graphics into LaTeX

1. Several packages are available for importing pictures into LaTeX document
2. Commonly used package is graphicx [add `\usepackage{graphicx}` in the preamble]
3. To include graphic file use:
   `\includegraphics[attr1=val1, attr2=val2, ..] {filename}` [common: attributes width, height, keepaspectratio=t/f, scale, angle, trim=l b r t, clip=t/f, page]
4. Recommended to use figure environment - `\begin{figure}[pos] ... \end{figure}`
5. LaTeX will insert the figure into the document wherever it seems best, but there are a few optional commands:

```
h - put figure here          t - put at top of page
b - put at bottom of page    p - put on separate page
```

6. LaTeX will automatically number figures and update list of figures page
7. Supports only .eps graphic format if compiled with latex command
8. If pdflatex is used for compilation a wider choice is available (.jpg, .png, .pdf)

```
\begin{figure}
\centering
\includegraphics[scale=0.2]{figure1.jpg}
\caption{Digital Typography Using LaTeX}
\end{figure}
```

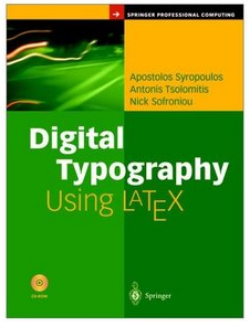


Figure: Digital Typography Using LaTeX

Table of Contents, List of Tables & Figures

1. Table of Contents can be generated automatically using the command:
   `\tableofcontents`
2. Place the command where ToC has to appear, usually right after the `\maketitle`
3. `\tableofcontents` takes entries from the sectioning commands
4. Run latex command twice to generate ToC whenever new entries are added
5. Default ToC will list headings of level 2 (subsection) and above
6. To increase or decrease with Depth use:
   `\setcounter{tocdepth}{4} % upto subsubsection`
7. The commands `\listoffigures` and `\listoftables` work exactly the same way as `\tableofcontents` and adds list of figures & list of tables
8. `\listoffigures` and `\listoftables` take entries from the captions given for figures and tables respectively

[Example]

Indexing in LaTeX

1. Useful in printed books
2. LaTeX supports creation of indices using the package `makeidx` & it support program `makeindex`
3. To enable the indexing feature of LaTeX:
   `\usepackage{makeidx} % in the preamble`
4. Then enable indexing command by:
   `\makeindex`
5. Then use: `\index{key}` after the keyword in the text

Example	Index Entry	Comment
`index{\LaTeX}`	LaTeX, 1	Plain entry
`index{\LaTeX!commands}`	LaTeX, commands, 2	sub-entry under LaTeX
`\index{TeX|see{LaTex}}`	TeX *see* LaTeX	Cross-reference
`\index{TeX|seealso{LaTex}}`	LaTeX *see also* TeX	Cross-reference

1. To print/show the index use: `\printindex`
2. To compile with makeindex command or select TeXify from WinEdt TeX menu

[Example]

Bibliography Management in LaTeX

1. Basic bibliography support - embedded within LaTeX document
2. BibTeX is the standard tool for creating bibliography in LaTeX
3. First create a database of references in a file with .bib extension - [Example]
4. Many publishers provide references in BibTeX format
5. How to cite?

```
\cite{cite_key} % include inline citation + item to reference list
\cite{cite_key1, cite_key2, cite_key2} % multiple citations
\nocite{cite_key} % only adds the item to reference list
\nocite{*} % include all entries to the reference list
```

6. To make the bibliography appear in the document:

```
\bibliography{filename}
\bibliographystyle{plain}
```

7. `natbib`[1] package is a re-implementation `\cite` command, to work with both Numerical and Harvard style citations

Some bibliography styles	
plainnat	ordered alphabetically
abbrvnat	first names & names of journals & months are abbreviated
unsrtnat	not ordered alphabetically
IEEEtranN	style for IEEE publications
achemso	style for ACS journals
rsc	for RSC journals

Basic natbib commands	
`\citet{jon90}`	Jones et al. (1990)
`\citet[chap.2]{jon90}`	Jones et al. (1990, chap.2)
`\citep{jon90}`	(Jones et al., 1990)
`\citep[chap.2]{jon90}`	(Jones et al., 1990, chap.2)
`\citep[see][]{jon90}`	(see Jones et al., 1990)
`\citep[see][chap.2]{jon90}`	(see Jones et al., 1990, chap.2)
`\citet*{jon90}`	Jones, Baker, and Williams (1990)
`\citep*{jon90}`	(Jones, Baker, and Williams, 1990)

[1] http://merkel.zoneo.net/Latex/natbib.php

Bibliography Management in LaTeX

Compiling the bibliography

1. Compiling latex document with bibliography requires the following steps:
   - `run latex on the .tex file - latex <file_name>`
   - `run bibtex on the .tex file - bibtex <file_name>`
   - `run latex twice more - latex <file_name>`
2. Subsequent latex runs allow the system to resolve the link between the document & the BibTeX file
3. Each time new references are added the above steps must be repeated

BibLaTeX:

1. another package which provides advanced bibliographic facilities for use with LaTeX in conjunction with BibTeX
2. This package supports subdivided bibliographies, multiple bibliographies within one document, and separate lists of bibliographic short-hands

Bibliography Assistance:

1. An external program can be used to manage the bibliography file (.bib)
2. A good program for this is Jabref (Free s/w)
3. Jabref is available at http://jabref.sourceforge.net/

[Example]

Publisher specific packages

1. achemso[1] The official macros & styles for submission to the journals of the American Chemical Society. Also style files to be used for bibliography listings are also provided
2. elsarticle[2] - is Elsevier's document class for journal articles. BibTeX bibliographic style file for use with elsarticle.cls for each reference style used by various journals + general manuscript templates are also available.
3. biblatex-chem[3] The bundle offers a set of styles to allow chemists to use biblatex - The package has complete styles for:
   - all ACS journals;
   - RSC journals using standard (Chem. Commun.) style; and Journal of the German Chemical Society , thus covering a wide range of journals
4. Springer[4] - LaTeX Class, Template and BibTeX styles
5. RSC[5] also provide LaTeX Template & Bibliographic styles for their journals
6. LaTeX Style and BiBTeX Bibliography Formats for Biologists[6]
7. IISc has LaTeX Templates and BibTex styles for writing thesis[7]

[1] http://pubs.acs.org/page/4authors/submission/tex.html

[2] http://www.elsevier.com/wps/find/authorsview.authors/elsarticle

[3] http://www.ctan.org/pkg/biblatex-chem

[4] http://www.springer.com/authors/journal+authors?SGWID=0-154202-12-417499-0

[5] http://www.rsc.org/Publishing/Journals/guidelines/AuthorGuidelines/AuthoringTools/Templates/tex.asp

[6] http://www.lecb.ncifcrf.gov/ toms/latex.html

[7] http://etd.ncsi.iisc.ernet.in/instructions

Technical Texts - Mathematics

1. LaTeX uses a special math mode to display mathematics
2. There are four different types of math mode:
   - Math environment - Short in-line equations
     a) `\begin{math}...\end{math}` b) `\(...\)` c) `$...$`
   - Displaymath environment - equations set apart in the text
     a) `\begin{displaymath)...end{displaymath}`
     b) `\[...\]` c) `$$...$$`
   - Eqnarray Environment - Sequences of equations or very long equations
     `\begin{eqnarray[*]}...\end{eqnarray[*]}`
   - Equation environment - Centered equations, automatically numbered
     `\begin{equation}...\end{equation}`
3. The amsmath[1] package provides enhancements tp math capabilities of LaTeX

```
\[
I = \int\limits_0^\infty\sin^2xdx
\]
```

$$I = \int\limits_0^\infty \sin^2 x dx$$

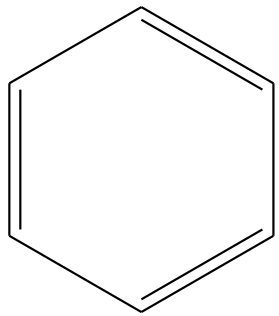
[Example]

[1] http://www.ams.org/tex/amslatex.html

Technical Texts - Chemistry

1. mhchem[1] chemistry package provides commands for typesetting chemical formulae and equations
2. Usage: `\usepackage[version=3]{mhchem} % at preamble`
   `\ce{H2O}` - H_2O
   `\ce{Sb2O3}` - Sb_2O_3
   `\ce{CO2 + C <=> {CO2}}` - $CO_2 + C \rightleftharpoons CO_2$
   `\ce{H+}` - H^+
3. chemfig[2] package allows drawing of molecules
4. Usage: `\usepackage{chemfig} % at preamble`
5. Command for drawing molecules is:
   `\chemfig{code}`
6. Example: `\chemfig{H-O-H}`

`\chemfig{*6(-=-=-=-)}`



7. chemfig package support is only available for pdflatex compiler

[Example]

[1] http://www.ctan.org/pkg/mhchem
[2] http://www.ctan.org/pkg/chemfig

References

1. CTAN (Comprehensive TeX Archive Network http://www.ctan.org/
2. Wikibooks.org http://en.wikibooks.org/wiki/LaTeX/
3. LaTeX Books:
   - LaTeX: A Document Preparation System by Leslie Lamport
   - The Not So Short Introduction to LATEX2e Or LATEX2 in 157 minutes by Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl, April 2011
   - LaTeX Concisely by Adrian Johnstone
   - The LaTeX Companion by Michel Goossens
   - A Guide to LaTeX by Melmut Kopka
   - LaTeX for Scientists and Engineers by David J. Buerger
   - The LaTeX Graphics Companion
   - The LaTeX Web Companion
4. Numerous online tutorials & guides are available specific commands, packages, etc.

Conclusion

1. LaTeX is a document preparation system with professional quality output
2. Pre-set standards are available
3. Many publishers provide LaTeX document classes, model templates and bibliographic styles to help authors
4. For a specific formatting problem, most probably there will be a dedicated package
5. CTAN is the first place where we should search for help
6. LaTeX is a mark-up-language, so there is some learning curve
7. Requires effort & time to learn
8. LaTeX is well suited for S & T literature
9. Writing only one thesis /dissertation will pay off all additional efforts
10. And not to be forgotten - LaTeX is completely free of charge

THANK YOU !